The Effect of the Madden-Julian Oscillation (MJO) and 200 mb Velocity Potential Anomalies on 2001 Southern Hemisphere Tropical Cyclogenesis

LCDR Stacy Stewart, USNR
NPMOC/Joint Typhoon Warning Center
Pearl Harbor, HI

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The Madden-Julian Oscillation (MJO

- **The MJO is a naturally occurring component of the coupled ocean-atmosphere system. It significantly affects the atmospheric circulation throughout the global tropics and subtropics, and also strongly affects the position and strength of the jet stream and atmospheric circulation features over the entire earth.**

- **The MJO has a <u>modulating effect on tropical cyclone</u> <u>activity world wide</u>. Thus, it is very important to monitor and predict MJO activity, since this activity**

- **The MJO is characterized by an eastward progression of large regions of both enhanced and suppressed tropical rainfall, observed mainly over the Indian Ocean and Pacific Ocean. The anomalous rainfall is usually first evident over the western Indian Ocean, and remains evident as it propagates over the very warm ocean waters of the western and central tropical Pacific.**

- **This pattern of tropical rainfall then generally becomes very nondescript as it moves over the cooler ocean waters of the eastern Pacific, but reappears over the**

- **There are distinct patterns of lower-level and upper-level atmospheric circulation anomalies which accompany the MJO-related pattern of tropical rainfall. These circulation features extend around the globe and are not confined to only the eastern hemisphere.**

- **Thus, they provide important information regarding the regions of ascending and descending motion associated with particular phases of the oscillation over those parts of the tropics where rainfall is generally low or absent.**

- **There is strong year-to-year variability in MJO activity, with long periods of strong activity followed by periods in which the oscillation is weak or absent. This interannual variability of the MJO is partly linked to the ENSO cycle.**

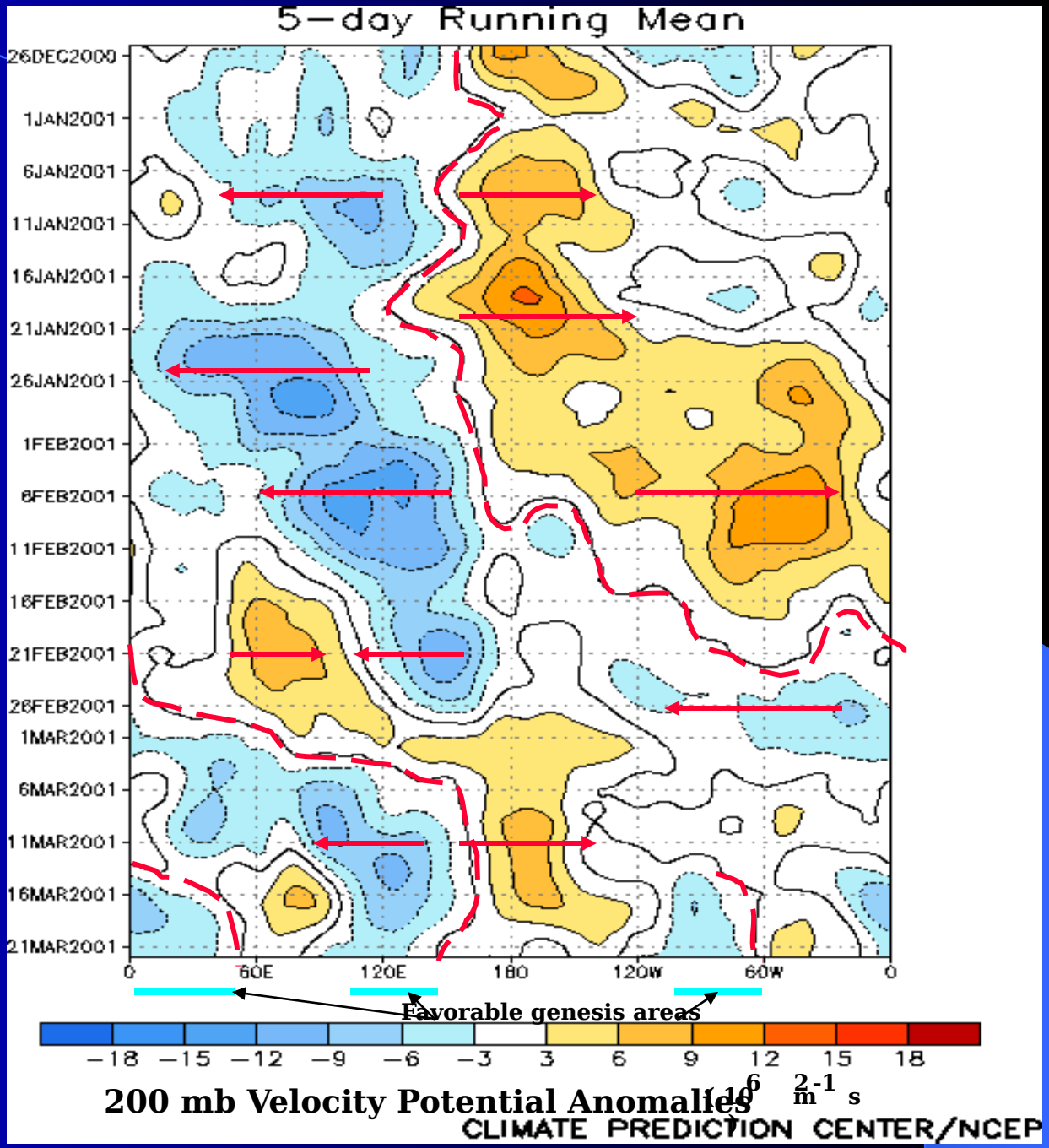
- **Strong MJO activity is often observed during weak La Niña years or during ENSO-neutral years, while weak or absent MJO activity is typically associated with strong El Niño episodes.**

- **TC-genesis is <u>most favorable</u> in areas of <u>negative</u> 200 mb Velocity Potential Anomalies (VPA) where westerly winds**

- **While not a true divergence field, the 200 mb Velocity Potential Anomaly (VPA) chart can be used to locate areas of favorable upper-level flow conditions.**

- **<u>Assuming all other TC-genesis factors are in place</u>, the area most favorable for TC-genesis on the 200 mb VPA chart will be in the transition zone (- - -) from positive VPA values (i.e., zonal or westerly winds) to negative VPA values (easterly winds).**

- **Although there will be day-to-day variability in the actual zonal wind flow, the 5-day running mean will better assess the <u>long-term</u> potential for TC-genesis <u>and</u> maximum**



The next slide is a plot of twelve 2001 Southern Hemisphere TC-genesis locations (longitude) as a function of time on the 21 March 2001 NCEP Climate Prediction Center's 5-day running mean 200 mb Velocity Potential Anomaly chart

The following features should be noted on this plot:

- **11 of the 12 TCs formed in areas of <u>negative</u> 200 mb velocity potential anomalies (i.e., easterly flow); the one lone TC (#14) that formed outside a negative VPA region did so in area of very weak positive VPA (westerly winds); given that the VPA values are 5-day means, the storm likely developed in a region transitioning flow from easterly to westerly direction; however, this TC was moving toward increasing positive VPA values (i.e., increasing westerly winds) and only reached 45 kt peak intensity.**
- **The strongest TCs formed in areas of <u>small</u> (<6 shear) 200 mb negative velocity potential anomalies; this indicates that little or no vertical shear was present which better allowed the systems to approach there maximum**

rm # / Name	Max Intensity
S (ANDO)	125 kt
S (BINDU)	100 kt
S (CHARLY)	105 kt
S (TERRI)	50 kt
P (WINSOME)	40 kt
S (VINCENT)	35 kt
P	35 kt
P (OMA)	45 kt
P (ABIGAIL)	65 kt
P (PAULA)	105 kt
P (RITA)	45 kt
S (DERA)	75 kt

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